Cabot Station Electric Generating Plant, Gantry Crane
Montague City Road
Montague
Franklin County
Massachusetts

HAER No. MA-79

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Mid-Atlantic Regional Office
National Park Service
U. S. Department of the Interior
Philadelphia, Pennsylvania 19106

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HISTORIC AMERICAN ENGINEERING RECORD

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Location:	On Montague City Road, 2 miles south of Turner Falls on the Connecticut River, Town of Montague, Franklin County, Massachusetts UTM: 18.698640.4717620 Quad: Greenfield 1:25000
Date of Construction:	1915
Engineer:	F. L. Hunt, Chief Engineer
Fabricator:	Exeter Machine Works, Pittston, PA
Present Owner:	Western Massachusetts Electric Company c/o Northeast Utilities Service Company P. O. Box 270 Hartford, Connecticut 06141-0270
Present Use:	Raising of tailgates; raking trash from trash rack; removal of ice from forebay. To be replaced by new crane, end of 1987.
Significance:	The gantry crane is an integral part of Cabot Station, an early and substantial example of American hydroelectric engineering. When built, the plant was the largest hydroelectric facility in New England. The crane was a special feature of the original design and illustrates the close functional integration of the plant's components.
Project Information:	This documentation was undertaken in June 1987 by the owner at the suggestion of the Massachusetts State Historic Preservation Office.
Prepared by:	Bruce Clouette Senior Historian Historic Resource Consultants 55 Van Dyke Avenue Hartford, Connecticut 06106 204-547-0268

HISTORICAL SICNIFICANCE

The Cahot Station Electric Generating Plant was huilt in 1915 hy the Turners Falls Power and Electric Company. Located two milee helow the dam on the Connecticut River, the station required a 1-1/2-mile exteneion of the existing power canal. It utilized 54 feet of head, high hy New England standarde. Its six turhine-generator sets produced 42,000 kw, making it the largest hydroelectric facility in New England at the time. Raising the canal emhankment in 1917 allowed an increase to 48,000 kw. The plant was considered a notahle example of up-to-date hydroelectric engineering, and it received considerahle notice in the technical publicatione of its day (see Bihliography). Descriptione of the plant appeared in major engineering texthooke of the period, including hoth the Wiley and McGraw-Hill seriee. Contemporary technical writers focueed on such features ae the Broome gates, the arrangement of components within the powerhouse, the smooth inside finish on the concrete penstocks and, consietently, the crane and rack cleaner. Barrows made especially heavy uee of the Turners Falle facility in his texthook (1927, rev. ed. 1943, pp. 242, 431, 510-17, 527-529, 662-663, 674, 742-744).

The crane and rack cleaner were in large part made necessary hy the size of the plant. Ite Broome gates, weighing five tone each and difficult to lift hecause of their inclined position when seated, were at the upper limit of conventional rack-and-pinion gate lifters. The alternative to a single movahle hoist was therefore 18 separate suhstantial mechanisms, each with its own motor and geare. Similarly, the traeh racks, 225 feet long and 30 feet high, were a challenge to keep free of dehrie. A mechanical rake which could travel the length of the rack was one solution; others were a series of fixed conveyor-helt rakes, each dedicated to a portion of the rack, or racks which could he raised and flushed (Rushmore and Lof, 1923, p. 97). The mechanical rake was a very inexpensive choice, given the need for the gantry to raise the gates. Neither was it particularly labor-intensive, except for periods of very heavy debris, when the crane could he moved and the rake operated hy one pereon. Sometimes an additional person assisted with dumping the traeh out of the rake and keeping it moving in the trough.

In addition to making its way into engineering textbooks, the arrangement at Cahot Station attracted the attention at other hydroelectric companiee. The files at Northeast Utilitiee contain several inquiries regarding the gantry and rack cleaner. In replying to the United Hudson Electric Corporation of Poughkeepeie, the superintendent of stations for Turners Falls Power and Electric Company noted that the trash rake worked quite succeeefully, sometimee hauling out several hundred tons of trash a day. He nevertheless recommended a greater slope to the trash racks and a wider trough as improvements (Northeast Utilities Service Company files, Document 8418790605, December 21, 1920).

Together, the gates, crane, rake and traeh trough illuetrate the point that Cabot Station was a carefully thought-out, completely designed facility. Reported to be one of the loweet-cost plants of the period (Electrical World, 1917, p. 742), its components work together to provide effective and economical solutions to the standard problems of hydroelectric generation. Examples abound, showing the functional integration of components, such as the formation of the penstocks and trash trough integral with the powerhouee foundation, and the water-level tubular gauges which signalled trash-rack obstructions inside the powerhouse. The crane is significant as another well-designed, original component of a facility that was large for its day and was the subject of much contemporary engineering interest.

The crane and rake was fabricated by Exeter Machine Works of Pitteton, Pennsylvania, a major producer of large mechanical etructures, euch as cranes and operating mechanisms for swing bridges. The company also provided the original gatee and roller chaine for Cabot Station.

Cabot Station and all of its components were designed by the engineering staff of Turners Falle Power and Electric Company. F. L. Hunt was chief engineer, assisted by H. M. Turner (hydraulic engineer), and H. A. Moody (powerhouse). The company coneulted with A. T. Safford of Lowell and F. P. Stearns of Boston. The contractor for the gates, penstock and powerhouee was Fred T. Ley of Springfield, Massachusetts, a large regionally-important construction firm.

The wider historical context for understanding the featuree of Cabot Station ie the coneolidation of the electric power industry, which made possible such large plants. Turners Falls Power and Electric Company was the successor to a company that had built a dam and canal for industrial power at Turners Falls in 1866. In 1905, the company extended its canal by 800 feet and built a 5,000 kw electric generating station, but for two years the plant had but a eingle customer, the Franklin Electric Light Company, and most of the potential power went unueed. Around this time, a group of Boston financiere, under the leadership of Philip Cabot, gained control of the stock of the Turners Falls company. Cabot became president, just ae he had assumed the leadership of several nearby utilities that the same interests had purchased, including the Greenfield Electric Light and Power Company, the Amherst Gas Company, the Amherst Power Company, the Easthampton Gas Company, the Agawam Electric Company, and the Ludlow Electric Light Company. Cabot revamped plans to build a low-head, 20,000 kw plant at the Montague site, instead choosing a larger plant to exploit the full head of a lengthened canal. The new plant, eight times larger than the one built only ten years earlier, supplied power to all the towns in the region. There was no repetition of the 1905 experiences, when 80% of the available power went unsold. Cooperative agreements with utilities such as the New England Power Company, United Electric Light Company (Springfield), Springfield Street Railway, Northampton Lighting Company, and Northern Connecticut Light & Power made the electricity produced at Turners

Falle available to a wide area. When Cabot retired in 1919, the company'e board named its flagship station after the departing president.

DESCRIPTION AND OPERATION

The gantry crane at Cabot Station consists of a large hoist, with a design capacity of 20 tons, mounted within a tall, slectrically-propellsd tower of rivetsd steel construction. The crane travels along rails straddling the 18 headgatss on the east (forsbay) side of ths large brick power station. In addition to its primary function of raising the penstock gates, the crane also has an electrically-powered rake to clear debris from the approximately 225 linear feet of trash rack in front of the penstock openings. Hoists, gearing, motors and controls are protscted from the weather by corrugated-metal siding which encloses a housing at the top of the crane and an operator deck about half way up ite height. The crane is an original feature of the 1915 powsr station. Despite some alterations, it retaine most of its historic form and materials.

The crane's superstructure has four legs, sach built of box-section lattice girders. The legs slant forward, so that in plan the crane measurss 14 by 14.5 feet at the bottom and 10.5 by 14.5 feet at the top of the legs. The lsgs are joined at the top by heavy plats girders and at the bottom by latticed box girdsrs. The bottoms of the legs are not joined on ths north and south sides, leaving the tower open in the direction of travel. Ths lege are braced in both directions with latticed paired angles.

On the east side of the crane is the open-grill operator deck with a partial enclosure framed out of steel angles. The deck is supportsd by I-beams riveted to the two east legs. Measuring 10 feet wide, the deck extends 5.5 feet beyond the east lege, with a shed roof for the ovsrhanging portion. At the top of the towsr is a second deck and the 6-foot-high housing for the main hoist and the drivs motor. The housing is framed out of stesl angles. Its shallow-pitched roof is now covered with corrugated fiberglass panels (originally corrugated stsel). A ladder on the north side of the crane provides access to ths operator deck, from which the top deck may be reached by a second ladder mounted on the south side exterior.

The crane travels on four pairs of 18-inch-diamster, cast-iron, double-flanged wheels, running on 75 pound rails spaced 14.5 feet on center. The motor for crane movemsnt is located at the northeast corner of the top housing. Power is transmitted to one wheel in each sst by a series of 3-1/2-inch shafts and bevel gears mounted on the outside of the tower. Power for ths drive motor, the hoist motor, and the trash-rake motor comes from a trolley attached to the southwsst leg; the crane runs on 3-phase, 60-cycls, 550-volt current.

The main hoist is mounted on I-beams atop the plate girders joining the lege; steel-plate frames support the motor, gearing, and drums for two wire ropes. The wire ropes are looped twice around double-sheave blocks on either eide of the large hoist hook.

The hoist raises the intake gate for the eix penstocks within the concrete foundation of the powerhouse. Each penstock has three gates, for a total of 18 gates ranged in a continuous row between the crane's rails. The original gatee, replaced in the 1950s, were steel-plate, Broome-type gates, running on roller chains. They weighed about five tone and measured 10 feet wide by 16 feet high. Metal covers (not seen in an early photo of the crane) protect the present gates. To raise the gate, the covers are removed, the crane is moved along the rails to a position over the gate, and the hook lowered to engage an eye atop the gate. Large eyebar links are sometimes used between the hook and fate. The gates drop by gravity. In addition to raising the gates to their fully-open position, the crane can raise them completely out of their guides.

The 6-foot-wide rake of the mechanical rack cleaner has 15 teeth, formed from forged steel bars. The rake is shaped like a cupped hand, with teeth mounted 5 inches apart on two rods and held in place by pipe spacers. The rods also carry two sets of 8-inch-wide guide rollere for the rake. The rollers initially run in a segment of curved track extending from the bottom girder on the east side of the crane outward to the top of the trash rack. Then, as the rake descends along the face of the rack, which typically is submerged 30 feet under the surface and is elanted outward at an angle 16 degree from vertical, the rollers are guided by the traeh-rack bars themselves.

Two eets of wire rope run from the rake to machinery on the operator deck. One set is for raising and lowering the rake along the racks; the other ie for lifting the front of the rake and then lowering it, eo it can scoop up debris. A single motor powers both motions, with a lever-actuated clutch to lift or lower the front of the rake.

Between the top of the trash racks and the crane's eaet rail is a continuous trough. When the rake is pulled out of the water, after have been dragged along the rack, accumulated debris falls into this trough for disposal.

The operator deck, in addition to the motor, gearing, and drums for the rack-cleaning mechanism, also includes controls for the main hoist and crane-travel motors. Two of these appear to be original and are marked "General Electric Patented October 19, 1897 and February 2, 1904." The other controls and cut-off switches are later modifications.

The crane has a emall boom made up of welded anglee mounted on the upper part of the southeast leg. This "jib crane" is a later replacement for a eimilarly-sized wooden crane which originally was mounted on the northeast leg. Its function is to lift large pieces of debris or eections of trash rack. Another addition is a wood and steel ice-boom, a paddle-shaped device attached to the bottom girder at the crane's southeast corner. When lowered into the forebay in front of the trash racke with the crane moving, the boom sweeps ice away from the intakes toward a sluice originally intended for paesing logs.

The crane today is substantially in good condition. Some minor modifications have already been noted -- the replaced jib crane, added ice boom, replaced controls, and fiberglass roof panels. The trash-rake hoisting mechaniem incorporatee a modern (c.1980) reduction gear. A large I-beam has been added to the inside of the eaet lege for holding sectione of trash rack being removed for eervice. Formerly, there were emall, square, steel pivot-eash windowe on the east side of the top housing, similar to those still extant on the east side of the operator deck enclosure. They have been replaced by doors. The outside catwalk for the top deck has been extended on the south and east sides. The corrugated-metal siding has been renewed. Sheet-metal covers over the wheels' bevel gears have had their seams welded.

The 72-year-old crane continues to perform all of its original functions. However, it does not conform to present-day code standards, and ongoing repairs are required to keep it operational. Replacement spare parts are no longer available.

BIBLIOGRAPHY

Abercromie, Fred C. The Turnsrs Falls Power and Electric Company, A Public Facility Since 1902. Turners Falls: Turnere Falle Power and Electric Company, 1925.

Barrows, H. K. Water Power Engineering. New York: McGraw-Hill Book Company, 1927; 3rd rev. ed., 1943.

Connell, B. R. "The Hydroelectric Development of the Turners Falls Power & Electric Company at Montague City, Mase.," General Electric Rsview 20 (March 1917): 226-38.

Engineering Society of Western Massachueetts. "Inspsction of Turners Falls Power & Electric Company's Hydro-Electric Development at Turners Falle, Mass., November 22, 1921." Typeecript, Northeast Utilitiee Service Company, Berlin, Connecticut.

"Largest Hydroelectric Plant in New England." Electrical World 69 (June 21, 1917): 740-44.

Northeast Utilities Service Company. Berlin, Connecticut. Correspondence, contracts, and drawings files, Cabot Station, 1915-.

Rushmore, David B. and Eric A. Lof. Hydro-Electric Power Stations. New York: John Wiley & Sons, 1917; 2nd rev. ed., 1923.

Turner, Howard M. "Hydraulic Redevelopment at Turners Falls, Mass." Engineering News 74 (July 29, 1915): 202-206.